CHEMICALS FOR AGRICULTURE

NOTABLE ADVANCE IN INSECTICIDES

By G. Belasyse Smith, N.D.A.

WARS always stimulate British agriculture, and the 1939-45 war, with the threat of starvation both during and after hostilities, has done so not less than its predecessors. The retention in civilian occupations of many promising young scientists resulted in much valuable research work being done, particularly in the development of insecticides and weedicides.

No outstanding advance in fertilizers has been made in the war years, but (to continue the metaphor) the position has been consolidated. The opportunity to review our knowledge and to present it in a practical and usable form has been taken by Dr. E. M. Crowther, D.Sc., F.R.I.C., of Rothamsted, in his Bath and West Society Pamphlet No. 13, 1945, and in conjunction with Mr. F. Yates in "A Fertilizer Policy in War-time." The reduction in the range of fertilizers produced has been noteworthy. Pre-war catalogues listed scores of fertilizers differing by trifling percentages of plant foods. Present-day lists rarely show more than half a dozen, the Ministry of Agriculture leading the way by sponsoring a single formulation suitable for all garden purposes, named the National Growmore Fertilizer.

THE MAIN PLANT FOODS

Of the three main plant foods only nitrogen is home produced. The urgent need for maximum production and the increase in arable acreage caused the consumption of nitrogen to rise fourfold. To meet this, and for other reasons, the Government erected a synthetic nitrogen plant at Prudhoe-on-Tyne. As the home consumption of nitrogen falls so its export potential (as sulphate of ammonia) should grow to meet a large unsatisfied oversea market in Spain, India, and China, and elsewhere. As regards the second plant food, phosphoric acid, which in pre-war days was almost wholly imported as phosphate rock or superphosphate, the chief war-time development was the importation of more concentrated forms, such as triple superphosphate and ammonium phosphate, thus saving shipping space. These fertilizers, in addition to being very effective, are dry and granular, and have become very popular, so much so that it has been announced that plant to make triple superphosphate will be erected in this country. Ammonium phosphate has been made here, for use by itself or as the basis of concentrated complete fertilizers, for a number of years. A more recent development is the making of a silicophosphate fertilizer by sintering ground phosphate rock with an alkaline material in the presence of silica.

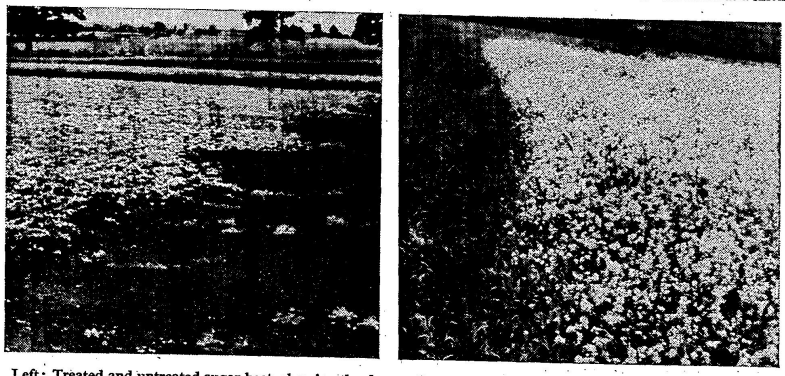
The ploughing of grassland which had been treated with phosphate fertilizers, particularly basic slag, brought one very interesting point to light regarding the availability of phosphates when added to the soil. It appears that at most 30 per cent. of the phosphate applied is available to the plant. In regions of high rainfall and acid soil the available percentage drops to 10. This has come as a shock to many who have almost religiously basic-slagged their grassland. Experiments are now being conducted to find a phosphate fertilizer which will not lose 70, 80, or 90 per cent. of its availability to the crop.

Supplies of the third main plant food, potash, were obtained before the war from the Alsace deposits. War-time supplies came from Palestine (the Dead Sea), Spain, and the United States. To economize in shipping space almost the whole of this was imported as muriate of potash, which proved quite satisfactory, to the surprise of potato growers and others who had previously insisted upon sulphate of potash. As all supplies of potash had to be seaborne, strict rationing was enforced, and, in consequence, attention was directed to home-produced substitutes. Of these, common salt was found to be very useful for sugar beet and mangels up to 5cwt. an acre; but to avoid any check to germination the salt had to be applied not less than three weeks before the seed was sown.

Before the war there was an enormous importation of animal feedingstuffs, which, evalued in terms of the nitrogen, phosphoric acid, and potash they contained, meant a very large amount of plant foods. Only a small percentage of such feedingstuffs is now imported, but the plant food figure has been maintained by direct importation of fertilizers. This is reflected in the fact that there has been no falling-off in the fertility of the fields and the high level of yields of such food crops as sugar beet and potatoes. Such yields have been discounted for several years in the writings of a number of well-meaning people, who have been termed collectively the "Compost" school. They claim with some vehemence that the use of mineral fertilizers is wrong in every way and that the only method of maintaining the health of the soil, and so the health of the nation, is to grow crops with compost made from organic wastes and to use deep-rooting plants which bring fertility from below. It is almost dangerous to incur the wrath of these persons, so strengthened are they with composted crops. The writer therefore shelters behind Mr. E. J. Salisbury, director of the Royal Botanic Gardens, Kew, who has written: "The presentation of manurial problems as a controversy concerned with organic manures versus mineral fertilizers is due to confusion of thought and complete failure to apprehend either the facts or the problem."

PLACEMENT OF FERTILIZERS

Two other points with regard to fertilizers deserve mention. The first is the work which has begun, and is continuing, on the placement of fertilizers. Is the orthodox method of scattering the fertilizer on the surface and working it in with harrows the best way of feeding the plants, or would the fertilizer be better in bands at fixed intervals and depths? The sowing of cereals together with fertilizers through a combined drill has now become common practice, but much work has yet to be done before all the questions are answered about all crops. The Ministry of Agriculture has been active during the war years in promoting the use of ground limestone as against burnt lime in various forms, hoping thus to save fuel and labour. A big increase in the use of this limestone dust has resulted from the opening of many Government-sponsored grinding plants. Evidence as to its efficacy is conflicting, as in all things agricultural, but on the balance not unfavourable.



Left: Treated and untreated sugar beet, showing the devastation caused by wireworm when the crop was not treated with "Gammexane." Right: A plot of wheat showing the control of charlock by "Methoxone" weedkiller.

D.D.T. AND "GAMMEXANE"

Undoubtedly the greatest advance of the war years has been made in the realm of insecticides. Two materials known to chemistry for many years have been found to possess remarkable insecticidal powers. These are dichloro-diphenyl-trichloroethane and benzene hexachloride. The former has become widely known as D.D.T. and the latter under the trade name of "Gammexane." The two materials are very different chemically, but have similar insecticidal properties, killing by contact or acting as stomach poisons under wet or dry conditions, and retaining their capacity to kill for several months after being distributed. For all their similarity, they appear to differ sufficiently to be complementary rather than competitive. The strength of these materials is such as to produce effective results from only 4 or 5 per cent. of the concentrate combined with various carriers. The use of these insecticides as an ingredient of decorative or protective finishes suggests the possibility of fly-free homes in the future. "Gammexane" is sufficiently heat-resistant to be distributed as a smoke, which is generated by burning it in powder, or other forms, the smoke depositing the insecticide on surrounding surfaces in the form of very fine crystals.

To those familiar with the "knock-down" effect of insecticides with a kerosine base, the slowness with which both D.D.T. and "Gammexane" act may give an illusion of ineffectiveness, but we are told that the slightest touch will mean certain death sooner or later. Space does not permit of any list of insects either susceptible or not affected by one or other of these insecticides, but it is of interest both at home and oversea to note that they attack the Colorado beetle with great success. Sheep dips are now being prepared which give promise of great effectiveness against ticks, keds, and the sheep blowfly, the maggots of which cause hideous injury to the living animal. Recent reports from Africa tell of encouraging results with D.D.T. against the tsetse fly, which is said to have been eradicated over extensive areas; and with "Gammexane" against a cattle tick which had proved resistant even to arsenic. Enormous possibilities against locusts are suggested by the recent successful campaign against this almost world-wide enemy of agriculture in Sardinia, where a sudden invasion was completely defeated by "Gammexane" specially flown out from England.

Before leaving the subject of insect pests, mention must be made of one which has, until recently, resisted all attempts at its control—that is, the wireworm—larva of the click beetle. Wireworms—perhaps the most common and also the most widely distributed of all root-feeding agricultural pests—occur in all kinds of soils and attack nearly every kind of crop. This pest appears to have sustained its first serious defeat by the use of "Gammexane."

WEEDICIDES

Since 1939 considerable developments have taken place in the chemical control of weeds. These have been along three distinct lines, (*a*) the specialized use of sulphuric acid, (*b*) the development of the weed-killing properties of a yellow dyestuff, dinitro-ortho-cresol, and (*c*) the revolutionary discovery of the selective killing properties of growth-promoting hormone substances, particularly 2:4 dichloro-phenoxyacetic acid and 2 methyl 4 chlorophenoxyacetic acid. To the man-in-the-field these names are so staggering they have to be shortened to initials such as D.N.O.C., D.C.P.A., and M.C.P.A.

Sulphuric acid had been used widely before the war for the destruction of charlock and other weeds in cereals, but its corrosive action upon machinery and the discovery of the other materials mentioned above have tended to divert its use to overcoming weeds, especially among onions, which are an increasingly important crop. The first method to be adopted was to spray the seedling onion once it had straightened, for it proved sufficiently waxy to withstand the strength of acid required to kill the annual weed. A later method was the use of acid to kill seedling weeds which developed between the sowing of the onion seed and the emergence of the seedling onions. This was followed, if necessary, by a second spraying after the seedlings had straightened. Sulphuric acid is the most effective material yet discovered for these purposes.

A great deal of work has been done on the use of D.N.O.C. and its mineral salts, and there are a number of proprietary weedkillers on the market, each said to be effective against the commoner weeds of arable land. One of the drawbacks to the use of D.N.O.C. is that it dyes the worker and his clothing a bright yellow. Another disadvantage is that it definitely retards the crop when it is applied. For these reasons the announcement of the discovery of a truly selective weedkiller was received with the greatest possible interest, not least by amateur gardeners, who thought that at last the Curse of Adam had been removed.

They were doomed to some disappointment, however, for those working upon D.C.P.A. and M.C.P.A. were cautious in their claims. At the moment, destruction is claimed only for charlock, pennycress, and at most half-a-dozen of the commoner weeds of the cornfield and pasture land, and great caution is urged in the use of these strange materials elsewhere.

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